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POSITION LOCATION REPORTING SYSTEM (PLRS) OT II
HUMAN FACTORS AND TRAINING EVALUATION

Edwin R. Smootz

Submitted by

George M. Gividen, Jr., Chief
ARI FIELD UNIT AT FORT HOOD, TEXAS

and

Jerrold M. Levine, Director
SYSTEMS RESEARCH LABORATORY



U. S. Army

Research Institute for the Behavioral and Social Sciences

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A human factors and training evaluation of the Position Location and Reporting System (PLRS) was conducted in conjunction with OTEA Operational Test II of the system at Fort Hood, Texas. Data were collected by administering questionnaires to and interviewing system operators, system maintainers, and unit leaders. Most of the human factors problems which were identified related to operating and maintaining the master station, whereas most of the training problems which were found centered on the user unit training program.		

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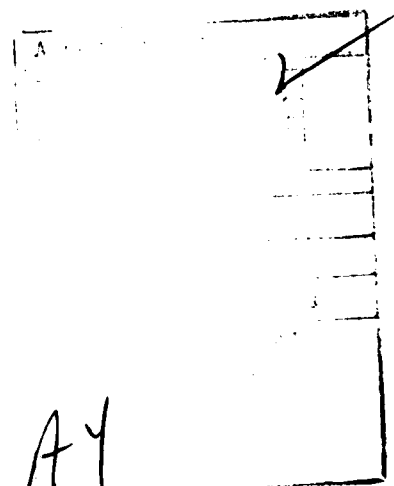
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FOREWORD

The modern Army is currently in the process of being equipped with an unprecedented amount of equipment incorporating a high degree of technological sophistication. Much of this equipment is extremely expensive and can only be procured in limited quantities. Consequently, it is essential that the capabilities of such equipment be utilized to the fullest extent possible. Two factors frequently interfere with the utilization of such equipment to its fullest capacity. One factor concerns the interface between the piece of equipment itself and the individual who is operating it. When the man and the machine are not compatible the machine will not be used efficiently and its effectiveness on the battlefield will be reduced. The other factor concerns training. Quite obviously, individuals who are not adequately trained to operate a piece of equipment will usually not be able to employ it effectively.

In order to identify and help rectify these problems the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) frequently conducts human factors and training research relating to Army equipment and personnel in an operational field environment. The present human factors evaluation of the Position Location Reporting System (PLRS) is representative of such efforts.

This evaluation was conducted at Fort Hood, Texas in the Fall of 1981 in conjunction with the Operational Test and Evaluation Agency (OTEA) Operational Test 428. The following report appears as "Appendix B, Human Factors" in the test report for PLRS OT II entitled Position Location Reporting System U.S. Army-U.S. Marine Corps Operational Test II, FTR-OT-428, U.S. Army Operational Test and Evaluation Agency, March 1982. It is reproduced here exactly as it appears in that report. Further details about the operational test and PLRS can be found in that report.



POSITION LOCATION REPORTING SYSTEM (PLRS) OT II
HUMAN FACTORS AND TRAINING EVALUATION

BRIEF

Requirement:

This research was conducted as part of a human factors analysis of the Position Location Reporting System (PLRS) which underwent operational testing at Fort Hood, Texas in the Fall of 1981. The research was conducted in conjunction with Operational Test 428 conducted by the U.S. Army Operational Test and Evaluation Agency.

Procedure:

Rating forms were used to collect data related to the adequacy of controls and displays within the system, the adequacy of procedures needed for satisfactorily operating the system, psychological and physiological symptoms which were experienced while operating parts of the system, safety hazards which were encountered, the adequacy of maintenance procedures, and the adequacy of the training program. These rating forms were administered to master station operators, user unit operators, unit leaders, and master station maintainers, and were followed up with interviews of these individuals in order to obtain clarification of ratings which were critical of the system.

Principal Findings:

• Master Station operators complained of a lack of storage space for combat and wet weather gear within the master station shelter. Additionally, they expressed some dissatisfaction with the cool temperature inside the shelter and the lack of adequate ventilation when several individuals were smoking inside the shelter. Although they had few problems performing the procedures necessary for operating the system, master station operators were dissatisfied with the responsiveness of the system. They also indicated difficulties in detecting and responding to electronic jamming. Technical manuals were criticized for their poor organization, inclusion of errors, and lack of information on how to respond to system alerts. The entrance to the shelter was criticized on the grounds that the steps leading to it were too steep and were very slippery when wet, and the cable reel was mounted in such a position that it was easy to bump one's head on it when reaching the top of the steps. Another safety problem concerned the fact that one operator reporting receiving an electric shock once while mounting the PLRS antenna. Operators reported various degrees of eyestrain, blurriness of vision and muscle strain after sitting at the display control station for several hours, but indicated that these symptoms disappeared with a 30 minute break. Wearing NBC protective

masks and gloves presented minor problems in mounting the antenna, connecting cables, and operating the display control station keyboard. Finally, training was viewed as generally adequate, although more hands-on training was desired.

● User unit operators indicated that they had no problems operating the system, but were very dissatisfied with system responsiveness to their information requests. False zone alerts were a particular problem. The user readout received minor criticism on the grounds that one needed to shade the display in order to read it, and one had to use a flashlight or memorize the position of the keys in order to enter information at night. The manpack user unit received specific criticism in having the low battery light mounted on the transceiver, which is carried on the back, rather than on the user readout where the user unit operator could see it. Additionally manpack user unit operators complained of the bulk and weight of the unit and the problems of getting the antenna and cable caught in tree limbs and brush. The recommendation was made that the cable connecting the user readout to the transceiver in a surface vehicle unit be secured to the floor of the vehicle to prevent entanglement with the legs of individuals entering and leaving the vehicle. Operating the system with NBC mask and gloves presented only a minor problem in trying to enter information via the keys on the user readout. Finally, substantial dissatisfaction was expressed with the training. User unit operators wanted hands on training in basic operating procedures and did not want lectures on technical aspects of the system.

● Unit leaders expressed substantial dissatisfaction with the responsiveness of the system. Accuracy and timeliness were seen as too variable. Particular criticism was directed toward the occurrence of false zone alerts, which tied up the system, precluding its use as either a position location indicator or a communications device and sometimes interfering with the conduct of tactical operations. The free text communications function was criticized for problems with determining who sent a message to a given unit and determining if a given unit had received a message. Training was criticized on the grounds that too much time was spent on technical explanations of how the system operated and not enough time was devoted to hands-on training in basic operating procedures.

● Master unit maintainers expressed some dissatisfaction with maintenance of the command response unit. Indications were that the command response unit test and the portable test unit were not highly reliable in diagnosing problems within the command response unit. It was also difficult to maintain the unit because of problems in gaining access to various components within it. Maintenance of the air conditioning system also presented problems because of its inconvenient location at the top front end of the shelter. Technical manuals were criticized as having errors throughout and being inadequately indexed. Equipment inadequacies included the lack of a signal message processor, lack of a KYK-13 for rekeying, the need for a set of Allen wrenches with handles, and the lack of a safe in the maintenance van large enough to hold the

KG-58 crypto device. Criticisms made by master station operators concerning the steep steps and inappropriately positioned reel at the entrance to the master station shelter were also made by the master station maintainers. Finally, the training was generally considered to be adequate, although more hands-on training in troubleshooting and fault finding would have been useful.

● User unit maintainers had few complaints. They indicated that the technical manuals which they were issued did not contain enough detail on such matters as the rekeying of units and checking the reliability of the portable test unit. The inclusion of schematics showing the check points for individual modules was also needed. Finally, there was an expressed need for access to a maintenance van.

Utilization of Findings:

The findings will be incorporated into the OTEA PLRS OT II final report and will be used in determining what modifications, if any, are needed to the Position Location Reporting System in its current stage of development.

POSITION LOCATION REPORTING SYSTEM (PLRS) OT II
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POSITION LOCATION REPORTING SYSTEM (PLRS) OT II
HUMAN FACTORS AND TRAINING EVALUATION

INTRODUCTION

The position location reporting system (PLRS) is a computer-based system designed to provide realtime three dimensional position and navigation information to selected elements within an Army Division, a separate Brigade, or a Marine Amphibious Brigade. Such a system can be expected to enhance a commander's control over his units, allow for more rapid fire support coordination, and provide more accurate position and navigation information to military units under a wide variety of environmental and tactical conditions.

The system consists of two master stations and 725 user units, although only 370 user units can be active at any given time. The central component of the system is the master station. It provides the network management and automatic data processing that is necessary for the system to function. It receives radio frequency pulses from the individual user units and through multilateration computes the location of each unit. This information, as well as other information such as messages, restricted zone locations, and the locations of other units, is transmitted by the master station to a user unit upon request.

The purpose of the present evaluation was twofold: 1) to determine whether there were any aspects of PLRS which adversely affected the ability of operators and maintainers to use and care for the system, and 2) to evaluate the PLRS training program from an operator and maintainer's point of view.

METHOD

This evaluation was accomplished by administering a series of human factors and training evaluation questionnaires to users and maintainers of PLRS and then following up with interviews to obtain clarification of responses given to the questionnaires. Questionnaires were administered to five groups of individuals, including master station operators, user unit operators, unit leaders, master station maintainers and user unit maintainers. The questionnaire formats and the questions themselves are presented with the response distributions in the RESULTS section of this report. The numbers of individuals receiving each questionnaire are shown in Table 1.

Table 1

NUMBERS OF SOLDIERS RECEIVING EACH QUESTIONNAIRE

	Human Factors Questionnaire	Training Evaluation Questionnaire
Master Station Operators	16	13
User Unit Operators	44	40
Unit Leaders	52	42
Master Station Maintainners	6	6
User Unit Maintainners	3	4

About one fourth of the respondents were US Marine Corps personnel and the remainder were US Army personnel. Almost all of the operators were high school graduates. The Army operators were in the grade of E3 through E5 with one to two years of service experience, while all of the Marine Corps operators were in the grade of E4 with 2 1/2 to eight years of service experience. Unit leaders ranged in grade from E3 to O3 with from 10 months to 30 years of service experience. The unit leaders who were officers possessed college degrees, while the enlisted unit leaders were high school graduates.

The questionnaires for evaluating the PLRS training program were administered to master station operators and unit leaders in late September, 1981, and to user unit operators, master station maintainers and user unit maintainers, in early October, 1981. All administrations were in a classroom. The human factors questionnaires were administered in the first week of December (the last week of the test) and were followed up immediately by interviews in which the evaluator requested clarification of negative response ratings. The interviews of the master station operators, master station maintainers, and user unit maintainers were conducted in groups of two to four individuals at a time. The interviews of the user unit operators and unit leaders were conducted in groups of about 10 individuals at a time. All interviews were conducted in an office setting.

RESULTS

Master Station Operator Human Factors Questionnaire

Responses to the Master Station Operator Human Factors Questionnaire are summarized in Table 2. It can be seen that most respondents considered the workspace in the master station to be generally adequate, although there was some dissatisfaction with the lack of storage space. During the interviews operators complained that there was no place to store one's combat gear and wet weather clothing. The observation was made by several operators that rotating the UYK-7 computer 90° would leave space for a storage cabinet and thus provide a solution to this problem.

Comments were also made by several operators that it became very cramped in the master station shelter van when more than three people were in it.

Finally, it was noted that since the master station supervisor usually sits on the left side of the shelter, it would be helpful if the printer and radio were located on that side since the supervisor is the individual who most frequently uses those two pieces of equipment.

Table 2 also shows that there was some dissatisfaction with environmental conditions within the master station. Operator comments revealed that it was frequently somewhat too cool for individual comfort inside the shelter, although it was still tolerable. Additionally, ventilation became a problem if more than three people were inside the shelter, especially if several of them were smoking. The high pitched sounds emitted from the equipment were also an annoyance to several individuals. Comments about illumination centered on the observation that some operators experienced mild blurring of vision after looking at the master station display for long periods of time.

Table 2 also reveals that there were several operating procedures with which master station operators showed some dissatisfaction. These included loading the crypto variable (question III-A-8), requesting adjacent master station date and time (question III-A-13), synchronizing the master station with an adjacent master station (question III-A-14), handing a user unit over to an adjacent master station (question III-D-6-d), and monitoring and evaluating transient units when sharing boundaries with another master station (question III-D-6-e). Those individuals who commented adversely about these functions, however, indicated that there were actually no problems in terms of their abilities to perform the actions necessary for initiating these procedures. Rather, the problem lay in the fact that the system would not respond to their actions. An operator, for example, would have to load a crypto variable numerous times before the system would accept it, or he would have to request date and time from an adjacent master station several times before receiving it.

TABLE 2

MASTER STATION OPERATOR HUMAN FACTORS QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N = 16)¹

I. WORKSPACE					
A. Using the scale to the right, indicate with a check mark (✓) the adequacy of the workspace in the PLRS Master Unit (MU) for each of the following factors:					
	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Leg room	<u>4</u>	<u>9</u>	<u>2</u>	<u>1</u>	<u>0</u>
2. Elbow room	<u>4</u>	<u>10</u>	<u>1</u>	<u>1</u>	<u>0</u>
3. Seating	<u>4</u>	<u>9</u>	<u>2</u>	<u>1</u>	<u>0</u>
4. Height of visual display	<u>5</u>	<u>9</u>	<u>1</u>	<u>0</u>	<u>0</u>
5. Overall configuration (location) of the MU equipment	<u>2</u>	<u>9</u>	<u>2</u>	<u>3</u>	<u>0</u>
6. Storage room (for papers, personal items, combat gear, etc.)	<u>4</u>	<u>5</u>	<u>4</u>	<u>1</u>	<u>2</u>
II. ENVIRONMENTAL CONDITIONS					
A. Using the scale to the right, indicate with a check mark (✓) the adequacy of environmental conditions in the PLRS Master Unit:					
	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Temperature	<u>0</u>	<u>10</u>	<u>3</u>	<u>3</u>	<u>0</u>
2. Ventilation	<u>1</u>	<u>10</u>	<u>3</u>	<u>2</u>	<u>0</u>
3. Noise	<u>0</u>	<u>12</u>	<u>2</u>	<u>2</u>	<u>0</u>
4. Vibration	<u>1</u>	<u>12</u>	<u>2</u>	<u>1</u>	<u>0</u>
5. Illumination	<u>1</u>	<u>11</u>	<u>2</u>	<u>2</u>	<u>0</u>

¹Note: Response frequencies in a given row may not sum to 16 because some respondents did not answer all questions in the questionnaire.

III. OPERATING PROCEDURES

Listed below are procedures performed by PLRS Master Unit Operators. Please rate, by using a check mark (✓), how easy or difficult it is to perform each of these procedures. If you cannot rate a procedure because you never performed it, check the "Did Not Perform" category.

A. Initialization (Principal Tasks)

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Verify no tapes in Cartridge Magnetic Tape Unit (CMTU).	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Bring up power to each piece of equipment.	<u>9</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Insert library and map tapes in CMTU.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Run self-tests.	<u>4</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
5. Load processors.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Enter system center.	<u>7</u>	<u>8</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Enter magnetic variation.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. Load crypto variable.	<u>5</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>0</u>	<u>1</u>
9. Execute START LIVE.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
10. Execute START SIM.	<u>5</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
11. Execute START PLAYBACK.	<u>5</u>	<u>7</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>3</u>
12. Enter date/time.	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
13. Request adjacent MU date and time.	<u>3</u>	<u>8</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>
14. Synchronize MU with adjacent MU.	<u>3</u>	<u>6</u>	<u>5</u>	<u>1</u>	<u>1</u>	<u>0</u>
15. Allocate trees.	<u>8</u>	<u>7</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
16. Add or assign reference units.	<u>7</u>	<u>7</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
17. Enter remote antenna parameters.	<u>4</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
18. Enter survey count parameter.	<u>3</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
19. Enter outside temperature parameter.	<u>6</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
20. Suggest or force Port Link Assignments.	<u>4</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
21. Suggest Cross Link Assignments.	<u>4</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
22. Set frequency hop-no hop.	<u>4</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>
23. Resolve position ambiguities.	<u>4</u>	<u>11</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>

B. Initialization (Secondary Tasks)

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Observe system alerts.	<u>5</u>	<u>9</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Update/modify map.	<u>6</u>	<u>7</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>
3. Set UU power levels.	<u>4</u>	<u>11</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
4. Identify and handle unknowns.	<u>4</u>	<u>9</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>

C. Preoperations

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Plan preoperations.	<u>6</u>	<u>6</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>3</u>
2. Annotate library with Area of Responsibility.	<u>6</u>	<u>9</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Annotate library with zones and corridors.	<u>7</u>	<u>7</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
4. Annotate library with reference items.	<u>6</u>	<u>8</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
5. Annotate library with symbols, modifiers, and text.	<u>6</u>	<u>9</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Create miscellaneous map lines.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Create/update UU library entries (e.g., ID, own/other, message set access).	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. Input other Master Unit ID's.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. Select and input reference UU's.	<u>6</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
10. Enter notices.	<u>7</u>	<u>7</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>
11. Input predesignated items to library.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
12. Record library tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
13. Load library tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
14. Record map tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
15. Load map tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
16. Create back-up copies of tapes.	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
17. Perform preventive maintenance check and services.	<u>3</u>	<u>8</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>

D. Operations

1. System Monitoring and Network Management.

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
a. Monitor and detect system alerts.	<u>7</u>	<u>7</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
b. Evaluate and respond to system alerts.	<u>6</u>	<u>9</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
c. Monitor and detect increases in advisories counts.	<u>7</u>	<u>7</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>1</u>
d. Evaluate and respond to NO REKEY advisories.	<u>5</u>	<u>9</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>1</u>
e. Evaluate and respond to NO MILID advisories.	<u>6</u>	<u>9</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
f. Evaluate and respond to NO TRACK advisories.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
g. Evaluate and respond to UU FAULT advisories.	<u>6</u>	<u>8</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>
h. Evaluate and respond to ZONE PEN advisories.	<u>6</u>	<u>8</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
i. Evaluate and respond to UU MSG advisories.	<u>7</u>	<u>7</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>
j. Evaluate and respond to DISPATCH advisories.	<u>7</u>	<u>7</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
k. Evaluate and respond to REF QUAL advisories.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
l. Authorize one time use of message set.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
m. Send messages to UU's.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
n. Restart UU.	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
o. Clear UU of crypto variable.	<u>7</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>2</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
p. Set UU inactive.	<u>6</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
q. Set power level of UU's.	<u>6</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
r. Respond to frequency hop or no-hop requests.	<u>4</u>	<u>4</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>4</u>
s. Respond to rekey network requests.	<u>5</u>	<u>9</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>
t. Initiate recomputation of unit location.	<u>5</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
u. Respond to unit survey requests.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
v. Manually enter unit location.	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
w. Assign unit to, or remove from, reference status.	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
x. Evaluate and respond to change requests from UU's (e.g., change MILID, message set, unit type).	<u>7</u>	<u>7</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
y. Evaluate unknowns which appear in net.	<u>4</u>	<u>9</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>2</u>
z. Hook units.	<u>11</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
aa. Use track ball.	<u>11</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
bb. Input and update navigation items (e.g., zones, corridors, and AOR's).	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
cc. Use function key emulation.	<u>8</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
dd. Detect attempts to jam PLRS.	<u>3</u>	<u>7</u>	<u>3</u>	<u>0</u>	<u>1</u>	<u>2</u>
ee. Respond to jamming of PLRS.	<u>2</u>	<u>3</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>3</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
2. Display Manipulation						
a. Select or deselect map information (e.g., map lines, symbols, text).	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
b. Display units (by type, by group, all).	<u>7</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
c. Display unit commo/ranging links.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
d. Display unit forced PLA.	<u>5</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>7</u>
e. Display unit tabular data.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
f. Select map scale.	<u>9</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
g. Offset a unit on the display.	<u>8</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
h. Enter location coordinates of offset unit.	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
3. Input and Update of Library Data.						
a. Authorize message set.	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
b. Set unit eligible or ineligible for handover to adjacent MU.	<u>7</u>	<u>8</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>
c. Assign notices to a message set.	<u>8</u>	<u>6</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
d. Input, update, or delete a unit library entry.	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
e. Change time/motion filter parameter.	<u>6</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
f. Record library tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
4. Input and Update of Map.						
a. Record map tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
b. Delete map.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
c. Reload map tape.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Collection and Playback.						
a. Enable or disable automatic data logging.	<u>8</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
b. Set level of automatic data logging.	<u>7</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
c. Obtain printout of information on <u>selected active</u> UU's.	<u>9</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
d. Obtain printout of information on <u>all active</u> UU's.	<u>9</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
e. Obtain printout of last known locations of <u>inactive</u> UU's.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
f. Obtain printout of system data.	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
g. Specify time of field exercise for starting playback.	<u>3</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>
h. Specify playback rate.	<u>3</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>7</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
6. Inter-PLRS Operation.						
a. Send dispatch to another MU.	<u>9</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
b. Enter AMU/ICID.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
c. Enter or delete requests from adjacent MU for unit position reports.	<u>7</u>	<u>8</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
d. Manually handover UU to adjacent MU.	<u>6</u>	<u>7</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>
e. Monitor and evaluate transient units when sharing Area of Responsibility (AOR) boundaries with another MU.	<u>5</u>	<u>7</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>
f. Obtain printout of transients.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
g. Enter change into library when accepting UU from adjacent MU.	<u>7</u>	<u>8</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
h. Create updated map and library tapes for AMU.	<u>6</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
i. Transfer system network to AMU.	<u>5</u>	<u>10</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
E. Power Down (Normal).						
1. Set all User Units eligible for handover.	<u>6</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>
2. Generate message of intent to shut down.	<u>4</u>	<u>11</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>
3. Reduce AOR to cause automatic handover of User Units.	<u>5</u>	<u>10</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
4. Record map and library tapes.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Remove tapes from Cartridge Magnetic Tap Unit.	<u>9</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Power off UYK-7 computer.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Power off UYK-20 computers.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. Power off keyboard/printer.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. Power off display control station.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
10. Power off command response unit.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
11. Power off Cartridge Magnetic Tape Unit.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
12. Power off air conditioning.	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
13. Secure the MU shelter.	<u>8</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
F. Power Down (Emergency)						
1. Remove tapes from cartridge magnetic tape unit, if time permits.	<u>8</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
2. Turn off MAIN SHELTER circuit breakers.	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
3. Report MU status to higher command.	<u>7</u>	<u>5</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>3</u>

IV. BUILT-IN-TEST EQUIPMENT (BITE)

Using the scale to the right, indicate with a check mark (✓) the adequacy of the following BITE tests.

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate	Did Not Perform
1. Display Control System (DCS) Panel Test.	<u>3</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>
2. DCS Off-Line Analog Test.	<u>3</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>
3. DCS Off-Line Digital Test.	<u>3</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>
4. DCS FFK/VFK and Track Ball Test.	<u>3</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>
5. Command Response Unit Test.	<u>3</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>

V. TRANSPORTABILITY

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform each of the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Displace the MU (i.e., prepare the MU for movement).	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>
2. Move the MU to another location.	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>
3. Emplace the MU (i.e. after arriving at a new location, prepare the MU so that it can be powered up).	<u>7</u>	<u>8</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>

VI. TECHNICAL MANUAL

Using the scale to the right, indicate with a check mark (✓) the adequacy of the PLRS Master Unit Operator's Manual (DEPTM 11-5825-268-10) in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Completeness	<u>1</u>	<u>6</u>	<u>6</u>	<u>3</u>	<u>0</u>
2. Accuracy	<u>1</u>	<u>5</u>	<u>9</u>	<u>1</u>	<u>0</u>
3. Understandability	<u>2</u>	<u>8</u>	<u>4</u>	<u>2</u>	<u>0</u>
4. Ease of finding necessary information	<u>1</u>	<u>6</u>	<u>7</u>	<u>2</u>	<u>0</u>

VII. SAFETY

- A. Indicate with a check mark (✓) if any of the hazards listed to the right exist for the following parts of the PLRS Master Unit:

	Electrical Hazard	Heat Hazard	Structural Hazard (protrusions, sharp edge, loose cables)	Mechanical Hazard (moving parts)	Extreme Brightness	Extreme Loudness
1. Display and Control Station	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Cartridge Magnetic Tape Unit	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Command and Response Unit	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Keyboard/Printer	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. VHF Voice Radio	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
6. Power Control Unit	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. AN/UYK-7 computer	<u>0</u>	<u>7</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. AN/UYK-20 computers	<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. PLRS antenna and mast	<u>1</u>	<u>0</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>
10. Entrance to/Exit from the Master Unit Shelter	<u>0</u>	<u>0</u>	<u>3</u>	<u>4</u>	<u>0</u>	<u>0</u>

VIII. PHYSICAL DISCOMFORT

Please indicate with a check mark (✓) the extent to which you experienced any of the following symptoms while operating the MU.

	Not at All	Mild	Moderate	Severe
1. Eyestrain.	<u>3</u>	<u>10</u>	<u>3</u>	<u>0</u>
2. Blurred vision.	<u>4</u>	<u>10</u>	<u>2</u>	<u>0</u>
3. Headache.	<u>9</u>	<u>4</u>	<u>2</u>	<u>1</u>
4. Dizziness.	<u>12</u>	<u>4</u>	<u>0</u>	<u>0</u>
5. Nausea.	<u>11</u>	<u>2</u>	<u>2</u>	<u>1</u>
6. Feeling too cold.	<u>3</u>	<u>4</u>	<u>6</u>	<u>3</u>
7. Feeling too hot.	<u>7</u>	<u>6</u>	<u>1</u>	<u>2</u>
8. Drowsiness.	<u>9</u>	<u>5</u>	<u>0</u>	<u>2</u>
9. Muscle strain in:				
a. Neck	<u>8</u>	<u>7</u>	<u>1</u>	<u>0</u>
b. Shoulders	<u>8</u>	<u>7</u>	<u>1</u>	<u>0</u>
c. Back	<u>6</u>	<u>9</u>	<u>1</u>	<u>0</u>
d. Stomach	<u>11</u>	<u>5</u>	<u>0</u>	<u>0</u>
e. Arms	<u>9</u>	<u>7</u>	<u>0</u>	<u>0</u>
f. Legs	<u>8</u>	<u>7</u>	<u>1</u>	<u>0</u>

IX. NBC PROTECTIVE CLOTHING.

1. During the PLRS test, what items of NBC protective clothing did you wear? (Check which of the following apply).

14 Protective mask
4 Protective hood
12 Protective gloves

2. How much time did you spend operating the MU while wearing the above clothing? Mean = 1.8 hours.
Mode = 2 Standard Deviation = .41 N = 14

3. Please indicate with a check mark (✓) how easy or difficult it is to perform the following MU operations while wearing the above NBC protective clothing.

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform With NBC Clothing
a. Initializing MU.	<u>1</u>	<u>9</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>1</u>
b. Performing Preoperations.	<u>1</u>	<u>8</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>1</u>
c. Operating the Command Response Unit.	<u>1</u>	<u>8</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>
d. Operating the Cartridge Magnetic Tap Unit.	<u>1</u>	<u>7</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>0</u>
e. Operating the Control Display System.	<u>1</u>	<u>5</u>	<u>6</u>	<u>2</u>	<u>0</u>	<u>0</u>
f. Operating the computers.	<u>1</u>	<u>7</u>	<u>5</u>	<u>1</u>	<u>0</u>	<u>0</u>
g. Operating other equipment in the MU (specify)						
<u>Entering FFK's and VFK's; typing</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
h. Powering down MU.	<u>4</u>	<u>7</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>
i. Using BITE.	<u>1</u>	<u>4</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>7</u>
j. Displacing MU.	<u>1</u>	<u>8</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>
k. Moving MU.	<u>1</u>	<u>9</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>
l. Emplacing MU.	<u>1</u>	<u>8</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>

Two other procedures with which some master station operators indicated they had problems were detecting and responding to jamming of PLRS (questions III-D-1-dd and ee). The major way of detecting that the system was being jammed appeared to be to notice a marked decrease in the percentage throughput of either the user measurement reports or the RF signals used in time of arrival calculations. This information appears in the top margin of the system display and is not readily detectable unless one happens to be purposefully observing that type of information. With respect to responding to jamming of PLRS, master station operators reported that there was little that they could do other than increase power and report rates of the user units, and this was often not effective.

Another area of dissatisfaction shown in Table 2 centered on the master station operator's technical manual. Over half of the respondents gave "Borderline" or "Inadequate" ratings in the areas of completeness, accuracy, and ease of finding necessary information. During the interviews it was revealed that operators primarily used the manual to obtain information on how to respond to faults and system alerts. They did not feel that the organization of the manual was very conducive to finding such information quickly, and they indicated that more information was needed. For example, fault 58 appeared in the left margin of the display several times, and a "% Utilization NCP" of 80 was quite common. The manual addresses neither of these situations. The operators felt that information should be in the manual telling the operator what actions, if any, he should take when such situations occurred. In short, the operators wanted more information on what they should expect to see in the margins of the display, especially with respect to system alerts, and specific instructions on what to do if other than normal values appeared.

Other criticisms of the manual included a lack of information on how to respond to jamming, and the occurrence of errors throughout. With respect to this last point, however, the operators said that the manual had been improved with the revision inserts that they had received during the test.

Section VII in Table 2 shows the responses that were given to questions concerning safety. The intent of this section was to obtain information about any safety problems which the operators actually experienced. However, the wording of the question was such that operators interpreted it to mean that they were to indicate if they thought that any safety hazards existed, whether they had actually experienced them or not. As a result, five operators indicated that there was an electrical hazard with the display and control station. In the interviews, however, it was revealed that these responses were intended to mean that they believed that there was a potential of getting shocked. No one reported actually getting shocked from that piece of equipment, or any other equipment within the master station. However one operator did report receiving a shock once when he was mounting the main PLRS antenna.

With respect to heat hazards, seven operators indicated that there was a problem with the AN/UYK-7 computer and five indicated the same with the AN/UYK-20 computers. Several other operators indicated a heat hazard with other pieces of equipment. However, the interviews revealed that what the operators had in mind was that the equipment sometimes overheated and failed as a result. None of the operators reported ever being burned by any of the equipment.

The most serious safety problem that was experienced by the operators concerned the portable steps that operators had to climb up and down when entering and exiting the master station shelter. Seven of the operators reported that these were a safety hazard. The interviews indicated that the steps were considered to be too steep and narrow, and that this was a particular problem at night or during wet weather when they became slippery as well. Wet weather also created a safety hazard when operators had to climb on top of the shelter to mount the antenna. In addition, several operators reported that upon reaching the top of the steps to enter the shelter at night, they sometimes bumped into the cable reel that was mounted to the left of the door. Mounting the reel to the right of the door so that it is some distance from the door handle would solve this problem.

Several operators indicated a structural hazard with some of the equipment. References were made to the following: cords which were in the way, as when, for example, the supervisor was talking on the VHF radio and had the handset cord stretched across the width of the shelter; somewhat sharp edges on the AN/UYK-7 computer that was at the entrance to the shelter; the location of the keyboard/printer in that one operator sometimes bumped his head on the shelf above when removing a printout from the printer; the fact that the cables to the keyboard/printer were too short to permit moving it to another location; and the fact that the rigid PLRS antenna will break if you hit a tree limb while moving the master station with the antenna mounted in place.

The final safety hazard which was mentioned was the loudness of the VHF radio. One operator mentioned that the volume had to be set too high for comfort in order to understand what was being said when one was using the speaker rather than the handset.

Section VIII in Table 2 shows the responses to questions about physical discomfort. Although all of the symptoms which were listed were experienced by some operators to some degree, the most common symptoms involved eyestrain and blurred vision, feeling too cold, and muscle strain. Feeling too cold has been discussed previously. Eyestrain, blurred vision, and muscle strain were reported by the operators to have occurred after sitting in front of the display console for three or more hours. Feelings of dizziness and nausea sometimes occurred with the eyestrain. The operators indicated, however, that all of the symptoms disappeared with a break of about 30 minutes and they could then resume their position at the display

console without experiencing the symptoms for awhile. In short, the symptoms which the operators reported are similar to those commonly reported by individuals who must sit in a relatively fixed position, looking at a visual display having high contrast characteristics for long periods of time.

The final set of questions shown in Table 2 (Section IX) focused on problems encountered while operating the master station in NBC clothing. Twelve individuals operated the master station for two hours while wearing both mask and gloves. Generally, their responses were distributed over the "Easy" and "Borderline" categories. In the interviews the operators indicated that using the protective mask did not cause much of a problem, but that there was somewhat of a problem in trying to operate the system while wearing protective gloves. Mounting the antenna, connecting cables, and operating the display control station keyboard were the most commonly mentioned problems. Several operators solved the latter problem by using the eraser end of a pencil instead of their fingers. Generally, these problems were seen by the operators to be of a minor nature.

Master Station Operator Training Evaluation Questionnaire

Responses to the Master Station Operator Training Evaluation Questionnaire are shown in Table 3. Overall, the training was rated quite favorably by the operators. Both the type of training and the quality of training were rated as "Satisfactory" or better for most of the areas listed, with two to five individuals frequently indicating that there was not enough training in the various areas listed. The area which received the poorest rating was "Recording and Playback Operations." There was some dissatisfaction expressed with the quality and type of training, as well as the amount of training, in this area. Also receiving somewhat less than satisfactory ratings were "Fault Recognition and Evaluation," which operators complained about earlier in the technical manual evaluation, "Use of Built-in Tests," and "User Unit Operational Methods." In the case of "Fault Recognition and Evaluation," three operators indicated that the quality of training was "Borderline," while with built-in test training and user unit training three operators felt that the type of training was "Borderline."

In the comments which the operators made there was one recurring theme: more hands on training is needed. This single statement summarizes the major complaint which the master station operators had with their training.

Finally, the last two questions in Table 3 indicate that while master station operators do not feel that they need highly frequent interaction with the PLRS system in order to maintain their skills for operating it, they do prefer a large amount of time (103 days on the average) over the course of a year with which to train on it.

TABLE 3

MASTER STATION OPERATOR TRAINING EVALUATION QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N=13)¹

1. Evaluation of training received in each of the following areas:

a. General Purpose and Use of PLRS.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	10	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	9	4	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	10	0	0	0

b. General Familiarization With the Equipment and Safety.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	10	2	0	0

¹Note: Response frequencies in a given row may not sum to 13 because some respondents did not answer all questions in the questionnaire.

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	8	5	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	0	0	0

c. System Emplacement and Power On/Off

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
4	9	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	12	1	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	10	0	0	0

d. System Software, Program Loading, and Start-up.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	13	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	11	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	0	0	0

e. Operator Switches and Controls Description.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	11	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
1	1	11	0	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	11	0	0	0

f. Function Key Description.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	10	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	13	0	0	0

g. Display Description.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	13	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	1	9	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	11	0	0	0

h. Preoperational Preparation (library generation and map planning).

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	11	1	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	11	1	1

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	10	1	0	0

i. System Monitor/Network Management (advisory review/evaluation/processing; no rekey/advance switch action; one-time message set authorization; send message; unit mode/power control actions; network parameter update actions; unit track control actions; unit link control actions).

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
4	7	2	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	9	4	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
4	7	2	0	0

j. Input and Update of Navigation Items.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	9	3	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	10	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	9	2	0	0

k. Display Manipulation.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	12	1	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	11	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	13	0	0	0

l. Input and Update of User and Library Data.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	9	2	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	1	7	4	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	13	0	0	0

m. Inter-PLRS Operation.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	0	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	1	10	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	12	1	0	0

n. Input and Update of Map.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	9	1	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	10	3	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	10	1	0	0

0. Recording and Playback Operations

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	9	4	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	8	5	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	11	2	0	0

p. Fault Recognition and Evaluation

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	12	1	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	11	2	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	10	3	0	0

q. Use of Built-in Tests

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	9	3	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	10	3	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	12	1	0	0

r. Preventive Maintenance

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	10	1	1	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	10	3	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	10	2	0	0

s. User Unit Operational Methods

(1) The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	9	3	0	0

(2) The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	9	4	0

(3) The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	11	1	0	0

2. The training literature for the master station was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	11	1	0	0

3. Overall, the amount of training on PLRS was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	9	4	0

4. Overall, the quality of training on PLRS was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	0	0	0

5. How often do you feel you would have to train to maintain your skills on the PLRS master station?

A	B	C	D	E	F
Daily	Weekly	Monthly	Every 3 Months	Every 6 Months	Once a Year
0	6	4	3	0	0

6. How many days of training per year do you feel would be needed to maintain your skills on the PLRS master station?

Mean = 103 days per year.

Standard Deviation = 82.7

N = 13

User Unit Operator Human Factors Questionnaire

Responses to the User Unit Operator Human Factors Questionnaire are summarized in Table 4. It can be seen that respondents generally had no problems with inspecting and assembling the equipment. The interviews revealed that the "Borderline" responses which several individuals made were an indication of the fact that little or no training was given in this area. Most respondents, for example, reported that they were not told anything about conducting preventive maintenance of the equipment. One comment that several operators made here was that they never observed the low battery light on the control panel come on, even when the batteries were low. It just did not seem to work. Furthermore, it was in a bad position. It really should have been on the user readout so that it could be easily seen. Several problems in the area of portability (Section II of Table 4) occurred with the manpack unit. Soldiers indicated some dissatisfaction with respect to backpacking the manpack unit (question II-A-1) and with respect to performing their primary duties while being responsible for the manpack unit (question II-A-2). In the interviews it was revealed that soldiers who served as riflemen felt that carrying the manpack unit in addition to their regular combat load was a rather strenuous job. Their primary complaint, however, was that the size and shape of the unit made it difficult to maneuver through terrain because the antenna would get caught in tree limbs and cables would get tangled in their feet and the brush. Additionally, rapidly hitting the ground while wearing the manpack unit was rather difficult.

Perusal of the Operating Procedures section of Table 4 reveals that several of the procedures received a substantial number of "Borderline," "Difficult," and "Very Difficult" ratings. In the interviews, however, the operators indicated that their dissatisfaction here centered not so much on problems in entering requests for information and generally operating the system, which they saw as fairly easy and straightforward, but rather on getting the system to respond to their requests for information. Frequent responses were "Standby" and "Cannot Comply." These were sources of extreme frustration to the user unit operators.

Zone alerts were a particularly severe problem. Frequently a user unit would receive a zone alert which was in error, but the user unit could not be used for anything else, such as sending messages or requesting position location information, because the zone alert dominated the user unit display until the master station had determined that the unit had moved out of the restricted zone.

With respect to detecting and responding to jamming (questions III-36 and 37) respondents indicated that if the system was working well then it was easy to detect jamming because suddenly there would be no response from the master station. However, if the system was not working very well on a given day, then it was difficult to tell if jamming was occurring or if the system was simply not functioning.

TABLE 4

USER UNIT OPERATOR HUMAN FACTORS QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N = 44)¹

Type of PLRS User Unit:

<u>24</u>	Manpack unit
<u>13</u>	Surface vehicle unit
<u>5</u>	Auxiliary ground unit
<u>0</u>	Airborne rotary-wing unit
<u>2</u>	Airborne fixed-wing unit
<u>44</u>	TOTAL

I. INSPECTING AND ASSEMBLING EQUIPMENT

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform each of the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform	Total N
1. Inspect equipment to make sure user unit is properly equipped.	<u>20</u>	<u>22</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>44</u>
2. Install antenna (applies only to manpack, surface vehicle)	<u>25</u>	<u>9</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>3</u>	<u>39</u>
3. Install/replace batteries (applies only to manpack unit operators)	<u>18</u>	<u>4</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>24</u>
4. Install/replace User Readout (URO) (applies only to manpack, surface vehicle, and auxiliary ground unit operators).	<u>16</u>	<u>17</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>4</u>	<u>42</u>

¹Note: Response frequencies in a given row may not sum to 44 because some respondents did not answer all questions in the questionnaire.

5. Replace manpack unit support equipment, such as sling, field pack, pack frame or URO holder (applies only to manpack unit operators).

Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform	TOTAL N
<u>7</u>	<u>9</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>6</u>	<u>24</u>

6. Perform preventive maintenance checks and services.

<u>14</u>	<u>10</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>13</u>	<u>42</u>
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II. PORTABILITY (applies only to surface units)

Using the scale to the right indicate with a check mark (✓) how easy or difficult it is to conduct each of the following activities:

A. Manpack Unit (MPU).

1. Backpack the MPU.
2. Perform primary soldier duties while being responsible for the MPU.

Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform	TOTAL N
<u>8</u>	<u>6</u>	<u>6</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>24</u>
<u>4</u>	<u>4</u>	<u>6</u>	<u>9</u>	<u>0</u>	<u>1</u>	<u>24</u>

B. Surface Vehicle Unit (SVU)

1. Mount and dismount the SVU.
2. Use vehicle in primary mode of operation while it serves as a SVU.

<u>3</u>	<u>9</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>13</u>
<u>2</u>	<u>7</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>13</u>

C. Auxiliary Ground Unit (AGU)

1. Move AGU to set-up site.
2. Emplace antenna, cables, and accessories.
3. Install basic user unit.
4. Remove basic user unit.
5. Dismantle antenna, cables, and accessories.

<u>0</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>5</u>
<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>5</u>
<u>1</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>

III. OPERATING PROCEDURES

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform each of the following procedures with a user unit.

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform	TOTAL N
1. Power-on user unit.	<u>24</u>	<u>11</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>42</u>
2. Power-off user unit.	<u>24</u>	<u>12</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>3</u>	<u>42</u>
3. Enter numbers or letters into the display fields of the user unit.	<u>16</u>	<u>19</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>2</u>	<u>41</u>
4. Store common messages.	<u>15</u>	<u>16</u>	<u>5</u>	<u>2</u>	<u>0</u>	<u>3</u>	<u>41</u>
5. Request bearing and range to a given position.	<u>14</u>	<u>17</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>4</u>	<u>42</u>
6. Request bearing and range of a predesignated item.	<u>12</u>	<u>16</u>	<u>7</u>	<u>0</u>	<u>0</u>	<u>6</u>	<u>41</u>
7. Request corridor guidance.	<u>4</u>	<u>13</u>	<u>6</u>	<u>2</u>	<u>1</u>	<u>15</u>	<u>41</u>
8. Receive corridor guidance.	<u>4</u>	<u>11</u>	<u>7</u>	<u>3</u>	<u>2</u>	<u>14</u>	<u>41</u>
9. Request bearing and range to a zone.	<u>8</u>	<u>16</u>	<u>7</u>	<u>1</u>	<u>0</u>	<u>10</u>	<u>42</u>
10. Detect a zone alert.	<u>9</u>	<u>16</u>	<u>6</u>	<u>3</u>	<u>1</u>	<u>7</u>	<u>42</u>
11. Respond to a zone alert.	<u>6</u>	<u>14</u>	<u>7</u>	<u>1</u>	<u>3</u>	<u>11</u>	<u>42</u>
12. Request the definition of a message (e.g., the MILID of an item or source of a notice; name of a corridor or zone).	<u>6</u>	<u>11</u>	<u>5</u>	<u>5</u>	<u>1</u>	<u>13</u>	<u>41</u>
13. Request that ranges be in English or Metric units.	<u>4</u>	<u>6</u>	<u>11</u>	<u>2</u>	<u>2</u>	<u>17</u>	<u>42</u>
14. Request elevation.	<u>8</u>	<u>13</u>	<u>4</u>	<u>2</u>	<u>0</u>	<u>15</u>	<u>42</u>
15. Send a free text message to the MU or Command and Control Center.	<u>12</u>	<u>13</u>	<u>8</u>	<u>4</u>	<u>1</u>	<u>4</u>	<u>42</u>
16. Send a free text message to user unit.	<u>16</u>	<u>14</u>	<u>5</u>	<u>1</u>	<u>1</u>	<u>5</u>	<u>42</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform	TOTAL N
17. Request heading and speed of a user unit.	<u>11</u>	<u>12</u>	<u>4</u>	<u>2</u>	<u>1</u>	<u>12</u>	<u>42</u>
18. Request MILID of a user unit.	<u>12</u>	<u>16</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>7</u>	<u>41</u>
19. Request change in MILID.	<u>3</u>	<u>5</u>	<u>6</u>	<u>5</u>	<u>3</u>	<u>19</u>	<u>41</u>
20. Request MILID for a user unit within 100 meters of a given point.	<u>5</u>	<u>8</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>22</u>	<u>42</u>
21. Request change in message set access.	<u>1</u>	<u>7</u>	<u>4</u>	<u>4</u>	<u>2</u>	<u>24</u>	<u>42</u>
22. Request a notice.	<u>2</u>	<u>5</u>	<u>7</u>	<u>2</u>	<u>2</u>	<u>24</u>	<u>42</u>
23. Change a notice.	<u>4</u>	<u>5</u>	<u>3</u>	<u>3</u>	<u>0</u>	<u>27</u>	<u>42</u>
24. Request to be made active or inactive.	<u>12</u>	<u>9</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>16</u>	<u>41</u>
25. Request own MGR position.	<u>16</u>	<u>15</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>8</u>	<u>42</u>
26. Request MGR position of another unit.	<u>14</u>	<u>13</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>9</u>	<u>42</u>
27. Request position of a predesignated item.	<u>11</u>	<u>8</u>	<u>6</u>	<u>1</u>	<u>0</u>	<u>16</u>	<u>42</u>
28. Upgrade position of a predesignated item.	<u>7</u>	<u>8</u>	<u>8</u>	<u>1</u>	<u>2</u>	<u>16</u>	<u>42</u>
29. Send non-PLRS derived MGR position to MU.	<u>3</u>	<u>7</u>	<u>3</u>	<u>3</u>	<u>0</u>	<u>25</u>	<u>41</u>
30. Request survey.	<u>10</u>	<u>17</u>	<u>6</u>	<u>2</u>	<u>1</u>	<u>6</u>	<u>42</u>
31. Request time and date.	<u>23</u>	<u>17</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>42</u>
32. Request report rate.	<u>5</u>	<u>9</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>24</u>	<u>42</u>
33. Request change in report date.	<u>5</u>	<u>7</u>	<u>4</u>	<u>1</u>	<u>1</u>	<u>24</u>	<u>42</u>
34. Request a position error estimate.	<u>3</u>	<u>8</u>	<u>6</u>	<u>1</u>	<u>1</u>	<u>23</u>	<u>42</u>

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform	TOTAL N
35. Cancel last User Readout request.	<u>10</u>	<u>11</u>	<u>2</u>	<u>0</u>	<u>2</u>	<u>17</u>	<u>42</u>
36. Detect electronic jamming of PLRS.	<u>6</u>	<u>6</u>	<u>4</u>	<u>4</u>	<u>7</u>	<u>15</u>	<u>42</u>
37. Respond to jamming of PLRS.	<u>9</u>	<u>0</u>	<u>7</u>	<u>5</u>	<u>5</u>	<u>16</u>	<u>42</u>
38. Read information off of the User Readout.	<u>17</u>	<u>15</u>	<u>3</u>	<u>3</u>	<u>1</u>	<u>3</u>	<u>42</u>
39. Perform preventive maintenance on user unit.	<u>12</u>	<u>10</u>	<u>2</u>	<u>2</u>	<u>0</u>	<u>16</u>	<u>42</u>

IV. BUILT-IN TEST EQUIPMENT (BITE)

Using the scale to the right, indicate with a check mark (✓) the adequacy of the following BITE tests:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate	Did Not Perform	TOTAL N
1. Built-in test #1 (started from Basic User Unit control panel).	<u>8</u>	<u>15</u>	<u>4</u>	<u>0</u>	<u>1</u>	<u>7</u>	<u>35</u>
2. Built in test #2 (started from User Readout or Pilot Control Display Panel).	<u>6</u>	<u>14</u>	<u>3</u>	<u>1</u>	<u>1</u>	<u>10</u>	<u>35</u>

V. TECHNICAL MANUAL

Using the scale to the right, rate the adequacy of the PLRS User Unit Operator's Manual in each of the following areas.

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate	TOTAL N
1. Completeness.	<u>3</u>	<u>14</u>	<u>14</u>	<u>3</u>	<u>3</u>	<u>37</u>
2. Accuracy.	<u>4</u>	<u>15</u>	<u>12</u>	<u>2</u>	<u>3</u>	<u>36</u>
3. Understandability.	<u>2</u>	<u>13</u>	<u>17</u>	<u>2</u>	<u>1</u>	<u>35</u>
4. Ease of finding necessary information.	<u>3</u>	<u>18</u>	<u>10</u>	<u>2</u>	<u>1</u>	<u>34</u>

VI. SAFETY

Indicate with a check mark (✓) if any of the hazards listed to the right exist for the following PLRS equipment:

	Electrical Hazard	Heat Hazard	Structural Hazard (protrusions, sharp edges, loose cables)	Mechanical Hazard (moving parts)	Extreme Brightness	Extreme Loudness
1. Basic User Unit (BUU)	<u>2</u>	<u>0</u>	<u>7</u>	<u>5</u>	<u>0</u>	<u>1</u>
2. User Readout (URO)	<u>4</u>	<u>0</u>	<u>3</u>	<u>6</u>	<u>2</u>	<u>0</u>
3. Pilot Control Display Panel PCDP)	<u>2</u>	<u>0</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>0</u>
4. Manpack frame and accessories	<u>0</u>	<u>1</u>	<u>8</u>	<u>4</u>	<u>0</u>	<u>0</u>
5. Surface Vehicle Unit mountings for BUU and URO.	<u>0</u>	<u>0</u>	<u>8</u>	<u>4</u>	<u>0</u>	<u>1</u>
6. Auxiliary Ground Unit mounting for BUU.	<u>0</u>	<u>1</u>	<u>4</u>	<u>4</u>	<u>0</u>	<u>1</u>
7. Auxiliary Ground Unit antenna, cables, and accessories	<u>0</u>	<u>1</u>	<u>7</u>	<u>4</u>	<u>0</u>	<u>1</u>

VII. NBC PROTECTIVE CLOTHING

1. During the PLRS test, what items of NBC protective clothing did you wear (check which of the following apply).

37 Protective mask.

13 Protective hood.

24 Protective gloves.

2. How much time did you spend operating a PLRS user unit while wearing the above clothing? Mean = 2 hours.
Mode = 2 Standard Deviation = 2.12
N = 28

3. Please indicate with a check mark (✓) how easy or difficult it is to perform the following operations while wearing the above NBC protective clothing.

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform With NBC Clothing	TOTAL N
a. Assembling User Unit equipment.	<u>3</u>	<u>13</u>	<u>4</u>	<u>3</u>	<u>0</u>	<u>10</u>	<u>33</u>
b. Replacing batteries.	<u>4</u>	<u>11</u>	<u>5</u>	<u>1</u>	<u>1</u>	<u>8</u>	<u>30</u>
c. Mounting and dismounting User Unit equipment.	<u>4</u>	<u>9</u>	<u>8</u>	<u>3</u>	<u>0</u>	<u>8</u>	<u>32</u>
d. Emplacing the Auxiliary Ground Unit.	<u>2</u>	<u>7</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>13</u>	<u>27</u>
e. Dismantling the Auxiliary Ground Unit.	<u>2</u>	<u>7</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>13</u>	<u>28</u>
f. Power on/off equipment.	<u>6</u>	<u>17</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>9</u>	<u>32</u>
g. Enter messages and requests into User Readout or Pilot Control Display Panel.	<u>4</u>	<u>17</u>	<u>3</u>	<u>0</u>	<u>2</u>	<u>6</u>	<u>32</u>
h. Read information from User Readout or Pilot Control Display Panel.	<u>6</u>	<u>15</u>	<u>6</u>	<u>0</u>	<u>0</u>	<u>6</u>	<u>33</u>
i. Perform BITE tests.	<u>3</u>	<u>11</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>12</u>	<u>28</u>

With regard to trying to overcome the jamming of PLRS, operators indicated that there was really nothing that they could do.

Operators' ratings on ease of reading information from the User Readout (question III-38) were quite satisfactory. Comments by individual operators were to the effect that although it was difficult to read the display in direct sunlight, shading it with one's hand or body brought about sufficient visual resolution. Additional comments focused on the user unit keys. At night it was impossible to see them without using a flashlight, which is tactically unsound. Several operators said that they had no problem here because they easily memorized the sequence of the keys. One operator suggested coating the letters and numbers on the keys with a luminescent paint so that they could be seen in the dark.

A few operators had problems with the BITE (Section IV in Table 4). In one instance an operator reported that his unit was not working but the BITE indicated no fault, while in another case the BITE indicated an antenna failure when in fact the system was working fine. None of the operators reported having problems running the BITE tests though.

The technical manual received numerous "Borderline," "Inadequate," and "Very Inadequate" ratings. The major complaints about the manual focused on its lack of sufficient information. One operator, for example, stated that the manual seemed to be written under the assumption that the reader already knew how to operate the system and merely needed some information about how to request certain types of information. Basic information on operating procedures and system functions was missing. Several other operators commented that they would like the manual to indicate all of the types of information that could be requested from the system and not just a small set representing the types of requests that user unit operators in a maneuver unit would typically use. They preferred to know what PLRS was capable of overall. A few operators, it might be noted, were fully satisfied with the amount of information in the manual.

With respect to safety considerations (Section VI in Table 4), operators indicated that the major problems lay in the fact that it was easy to get tangled up in the cable connecting the user readout to the transceiver with both the manpack unit and the surface vehicle unit. Making provisions for securing the cable to the manpack or side of a vehicle would be very helpful.

Although several operators indicated that an electrical hazard existed with some of the equipment, their intent here was to convey that a potential for electrical shock existed. None of the user unit operators reported actually getting shocked by any pieces of the equipment. Neither did they report receiving cuts or burns from the equipment.

Finally two operators reported that the light emitted by the user readout display at night, and the loudness of the audible buzzer, were tactically unsound and in that sense were safety hazards.

With respect to operating the user units while wearing NBC protective clothing (Section VII in Table 4), operators indicated that there was some difficulty because of a loss of dexterity caused by wearing gloves. However, they commented that this was a problem to which they adapted and that operating the user units with NBC protective clothing did not pose much of a problem.

User Unit Operator Training Evaluation Questionnaire

Responses to the User Unit Operator Training Evaluation Questionnaire are shown in Table 5. It can be seen that in every area but one (Power On/Off Procedures) over half of the respondents gave Borderline or worse ratings to the type, amount and quality of training. Individual comments revealed that there were not enough equipment and manuals on hand for the training and that the equipment that was available frequently did not work. Several comments were made to the effect that more individual hands-on training was needed. Also, the instructors spent too much time explaining how the PLRS system works internally, which the user unit operators saw as of little value to them at all, especially since they did not understand it. Finally several operators commented that the training was disorganized and that they had to spend too much time just standing around.

With respect to the frequency of training that operators judged was needed to maintain proficiency with the user units (question 5), it can be seen that most operators judged that training monthly or less would be adequate. The number of days per year of recommended training (question 6) averaged across operators was 64.

TABLE 5

USER UNIT OPERATOR TRAINING EVALUATION QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N = 40)¹

1. Evaluation of training received in each of the following areas:

a. General Purpose and Use of the PLRS User Unit.

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 39)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	11	10	10	5

(2) The amount of training was (N = 40)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
6	5	13	10	6

(3) The quality of training was (N = 40)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	11	10	11	6

b. Description of the User Unit

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 40)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	16	8	9	6

¹Note: Response frequencies in a given row may not sum to 40 because some respondents did not answer all questions in the questionnaire.

(2) The amount of training was (N = 39)

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
4	6	15	13	1

(3) The quality of training was (N = 40)

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
1	12	12	11	4

c. Assembling the User Unit

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 40)

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
2	18	8	8	4

(2) The amount of training was (N = 38)

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
3	2	23	9	1

(3) The quality of training was (N = 40)

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
2	15	12	7	4

d. Power On/Off Procedures

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 39)

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
2	19	10	5	3

(2) The amount of training was (N = 39)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
5	5	19	8	2

(3) The quality of training was (N = 38)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	14	12	4	5

e. Description of Types of Messages

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 39)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	13	8	12	5

(2) The amount of training was (N = 39)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
6	3	17	11	2

(3) The quality of training was (N = 39)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	14	9	9	6

f. Sending, Receiving and Storing Messages

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 38)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	8	12	5

(2) The amount of training was (N = 37)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
5	4	13	15	0

(3) The quality of training was (N = 37)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	12	8	11	5

g. Fault Recognition and Use of the Built-in Test

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 38)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	16	11	7	2

(2) The amount of training was (N = 38)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
7	4	17	10	0

(3) The quality of training was (N = 39)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	17	9	6	5

h. Preventive Maintenance Procedures

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 39)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
4	8	7	16	4

(2) The amount of training was (N = 38)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
4	5	15	12	2

(3) The quality of training was (N = 38)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	12	8	12	4

2. The training literature for the PLRS user unit was (N = 38)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	12	11	8	5

3. Overall, the amount of training on the PLRS user unit was (N = 39)

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
7	3	19	10	0

4. Overall, the quality of training on the PLRS user unit was (N = 39)

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
3	10	8	12	6

5. How often do you feel you would have to train to maintain your skills on the PLRS user unit? (N = 39)

A	B	C	D	E	F
Daily	Weekly	Monthly	Every 3 months	Every 6 Months	Once a Year
2	3	13	8	4	9

6. How many days of training per year do you feel would be needed to maintain your skills on the PLRS user unit?

Mean = 64 days per year.

Standard Deviation = 78.9

N = 30

Unit Leader Human Factors Questionnaire

Responses to the Unit Leader Human Factors Questionnaire are summarized in Table 6. It can be seen that there was a substantial amount of dissatisfaction expressed with the accuracy of PLRS location functions (questions I-1, 3, and 5). For example, over half of the respondents gave "Borderline" or worse ratings to the accuracy of PLRS information about their own unit location and other unit locations. Comments during the interviews revealed that leader dissatisfaction centered on the variability in the accuracy of the information from day to day and from moment to moment. All the leaders agreed that the position location information was very useful when it was accurate, but one just could not depend on it to be accurate consistently over time. Similar comments were made about satisfaction with the amount of time it took for PLRS to respond to a position location request (questions I-2, 4 and 6). When the system was working well, the unit leaders were very satisfied with its responsiveness. But often the system would respond with "Standby" or "Cannot Comply" and unit leaders found the frequency of such replies to be very exasperating.

A great deal of dissatisfaction was also expressed with the restricted zone function (question II). About as many unit leaders indicated that this particular function interfered with their ability to carry out tactical operations (18 of 48 unit leaders) as indicated that it helped carry out tactical operations (17 of 48 unit leaders). The interviews revealed two basic problems here. First, the restricted zone function was extremely unreliable in that it frequently indicated that a unit was in a restricted zone when in fact it was not. Sometimes this would occur even when a user unit had been in a stationary position for some time, an event which unit leaders found both amusing and annoying. Secondly, the occurrence of a zone alert in the user readout display precluded use of the PLRS system by that unit because once PLRS determined that a user unit had entered a restricted zone it maintained the zone alert message to that unit until the restricted zone had been exited. When the system was giving an erroneous zone alert message, as it frequently did, this eliminated the PLRS user unit as a useful position location or communications device.

Some dissatisfaction was also expressed with the free text communications function of PLRS (question III-1). In the interviews the unit leaders indicated that the problem here lay in the fact that one did not know who was sending him a message if no identifying letters arrived with the message, and one did not always know if a complete message that was being sent got through to the proper unit. Sometimes in the test only part of the message got through. One way to overcome this problem would be to have the unit receiving a message indicate that it had received a message after each transmission that filled the visual display. But with long messages this becomes very time consuming. Basically, it appears that the PLRS is not very amenable to use as a communications device for long messages. The FM radio performs this function much better.

TABLE 6

UNIT LEADER HUMAN FACTORS QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N = 52)¹

Type of PLRS Unit with which you had the most experience during the test (check one):

26 Manpack unit (MPU)
18 Surface vehicle unit (SVU)
6 Airborne rotary-wing unit (ARU)
2 Airborne fixed-wing unit (AFU)
 52 TOTAL

I. PLRS LOCATION FUNCTIONS

1. How satisfied were you with the accuracy of the information provided by PLRS about your unit location? (N = 52)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	5	3	0	0	8
Satisfied	7	4	2	2	15
Borderline	10	7	1	0	18
Dissatisfied	3	3	2	0	8
Very Dissatisfied	1	1	1	0	3

2. How satisfied were you with the amount of time required for PLRS to answer your requests for information about your unit location?(N = 51)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	4	4	0	0	8
Satisfied	15	8	2	0	25
Borderline	4	6	2	2	14
Dissatisfied	2	0	1	0	3
Very Dissatisfied	0	0	1	0	1

¹Note: Total response frequencies for a given question may not sum to 52 because some respondents did not answer all of the questions in the questionnaire.

3. How satisfied were you with the accuracy of the information provided by PLRS about other User Unit locations? (N = 51)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	3	1	0	0	4
Satisfied	13	5	1	1	20
Borderline	7	10	1	0	18
Dissatisfied	2	2	3	0	7
Very Dissatisfied	1	0	1	0	2

4. How satisfied were you with the amount of time required for PLRS to answer your requests for information about other User Unit locations? (N = 51)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	3	3	0	0	6
Satisfied	12	10	1	1	24
Borderline	9	5	1	0	15
Dissatisfied	2	0	2	0	4
Very Dissatisfied	0	0	2	0	2

5. How satisfied were you with the accuracy of the information provided by PLRS for navigating to a known point? (N = 52)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	5	1	0	0	6
Satisfied	10	9	3	2	24
Borderline	7	5	1	0	13
Dissatisfied	2	3	1	0	6
Very Dissatisfied	2	0	1	0	3

6. How satisfied were you with the amount of time required for PLRS to provide you with information for navigating to a known point? (N = 52)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	3	1	0	0	4
Satisfied	14	11	1	2	28
Borderline	8	3	3	0	14
Dissatisfied	1	2	1	0	4
Very Dissatisfied	1	0	1	0	2

II. RESTRICTED ZONE FUNCTION

Did the information PLRS provided on restricted zones (for example, alerts) help or interfere with your ability to carry out tactical operations? (N = 48)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Helped Tremendously	1	1	0	0	2
Helped	10	3	1	1	15
Neither Helped nor Interfered	7	4	2	0	13
Interfered	4	7	3	0	14
Interfered Tremendously	2	2	0	0	4

III. OTHER FUNCTIONS

1. How satisfied were you with the capability of PLRS to serve as a "free text communications channel" with other units? (N = 51)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	5	2	0	0	7
Satisfied	13	5	1	1	20
Borderline	4	7	0	0	11
Dissatisfied	3	3	5	0	11
Very Dissatisfied	1	1	0	0	2

2. How satisfied were you with the remaining message and information functions of PLRS (e.g., heading/speed, date/time)? (N = 52)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Satisfied	5	3	0	1	9
Satisfied	19	9	3	0	31
Borderline	0	5	1	0	6
Dissatisfied	1	0	1	0	2
Very Dissatisfied	1	1	1	1	4

IV. PERSONNEL REQUIREMENTS

1. Based upon your experience with PLRS, do you feel that only soldiers with a certain MOS or MOS's should be assigned to operate the PLRS User Units? (N = 52)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Yes	10	7	3	1	21
No	16	11	3	1	31

2. Do you feel that soldiers need certain specialized skills, in addition to training on the PLRS system, to effectively use the PLRS User Units? (N = 52)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Yes	14	13	2	1	30
No	12	5	4	1	22

V. PLANNING TIME.

How much interference did planning for PLRS operations have with performing your other military duties during the tactical portion of the test? (N = 50)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Much	3	2	0	0	5
Much	2	2	0	0	4
Some	13	5	4	0	22
Little	2	2	2	1	7
Very Little or None	6	5	0	1	12

VI. ORGANIZATION AND DOCTRINE

1. How adequate was your unit organizational structure (in the PLRS test) for supporting the deployment of PLRS? (N = 50)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Adequate	5	1	2	0	8
Adequate	9	8	2	1	20
Borderline	9	4	0	0	13
Inadequate	2	4	1	0	7
Very Inadequate	0	1	1	0	2

2. From a tactical point of view, how adequate was the doctrine that was used for employing PLRS during the field test? (N = 48)

	<u>MPU</u>	<u>SVU</u>	<u>ARU</u>	<u>AFU</u>	<u>TOTAL</u>
Very Adequate	1	1	1	0	3
Adequate	9	6	2	0	17
Borderline	9	5	1	0	15
Inadequate	3	4	2	1	10
Very Inadequate	1	1	0	1	3

With respect to personnel requirements (Section IV of Table 6), the unit leaders were split in their opinions. More than half of them felt that no special MOS was required for operating the user units, while at the same time over half of them felt that certain skills other than just training on the PLRS system was needed. Individual comments indicated that a soldier who was relatively intelligent, or at least had "good common sense," would be the one to whom they would assign the PLRS user unit.

In the area of planning time (Section V of Table 6) most unit leaders were of the opinion that PLRS did not substantially interfere with their other duties. In the interviews it was indicated that what planning was done usually involved deciding what to do in the event that PLRS went out of net.

Some dissatisfaction was revealed with questions about organization and doctrine (Section VI in Table 6). Unit leader comments here indicated that the only unit organizational problem was that a man had to be assigned to carry the PLRS and this took him away from other military duties to which he would normally be assigned. One unit leader expressed the wish that the PLRS user unit could be made small enough to be assigned to the unit's radio telephone operator.

With respect to doctrine, most comments were to the effect that no special tactical doctrine was given to be employed with PLRS, and that there was pressure during the test to ignore sound tactics, such as using overwatch techniques, and simply move rapidly in a dispersed pattern when going from one point to the next.

Unit Leader Training Evaluation Questionnaire

The response summary to the Unit Leader Training Evaluation Questionnaire is shown in Table 7. One particular area of the training was a source of dissatisfaction. Specifically, unit leaders indicated that too much time was spent on the general purpose and use of PLRS (question 1-a-(2) and on the description of PLRS (1-b-2). Individual comments indicated that the problem here was that there was too much discussion on technical aspects of the system, such as how the system computes unit positions and how time frames are divided into smaller unit time frames. Unit leaders indicated that what was needed instead was more training on what functions PLRS performs and how an operator causes PLRS to perform those functions.

TABLE 7

UNIT LEADERS TRAINING EVALUATION QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N = 42)¹

1. Evaluation of training received in each of the following areas:

a. General Purpose and Use of PLRS

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 41)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
7	24	9	1	0

(2) The amount of training was (N = 42)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
7	10	23	2	0

(3) The quality of training was (N = 42)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
9	21	9	3	0

b. Description of PLRS

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 41)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
8	29	3	1	0

¹Note: Response frequencies in a given row may not sum to 42 because some respondents did not answer all questions in the questionnaire.

(2) The amount of training was (N = 42)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
6	12	22	2	0

(3) The quality of training was (N = 42)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
9	23	9	1	0

c. Power On/Off Procedures for a User Unit

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 34)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
7	22	3	2	0

(2) The amount of training was (N = 35)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	4	28	3	0

(3) The quality of training was (N = 35)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
7	22	4	2	0

d. Description of Types of Messages

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 41)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
4	31	6	0	0

(2) The amount of training was (N = 42)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
1	3	28	10	0

(3) The quality of training was (N = 42)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
5	27	9	1	0

e. Sending, Receiving, and Storing Messages

(1) The type of training (lecture, conference, demonstration, or practical exercise) was (N = 40)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	26	9	2	0

(2) The amount of training was (N = 41)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	2	28	11	0

(3) The quality of training was (N = 40)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
5	24	9	2	0

2. The training literature for the PLRS was (N = 39)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
4	27	5	3	0

3. Overall, the amount of training on the PLRS was (N = 37)

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
2	8	23	4	0

4. Overall, the quality of training on the PLRS was (N = 37)

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
8	22	6	1	0

Master Station Maintainer Human Factors Questionnaire

Responses to the Master Station Maintainer Human Factors Questionnaire are summarized in Table 8. In the area of troubleshooting (Section I) some dissatisfaction was expressed with troubleshooting the command response unit and with using the portable test unit. Individual comments were to the effect that neither the Command Response Unit test nor the portable test unit were completely reliable in diagnosing problems in the command response unit.

With respect to major equipment removal and replacement, one maintainer gave a "Borderline" rating to removing and replacing the cartridge magnetic tape unit (question II-6), and another maintainer gave a "Borderline" rating to removing and replacing the cable assemblies. Both of these operators commented that it was difficult to get to these pieces of equipment or components thereof.

With respect to the electrical shelter subsystem maintenance (Section III in Table 8), adverse ratings centered on maintaining the air conditioners and the lights. Maintainers indicated that it was difficult to replace the air conditioner filters because one had to remove the air conditioner to do so. Also, the circuit breaker for the air conditioner compressor was in an inconvenient location, given the frequency with which it had to be reset. Resetting it involved climbing on top of the master station shelter and removing a number of screws from a top plate on the air conditioner in order to gain access to the circuit breaker. This top plate became somewhat unsecure during the course of the test because several of the screws were lost or discarded because of the frequent handling of this plate.

Maintainer comments about the lights referred to the florescent lamps with umbilical cords inside the master station shelter. There was insufficient play in the wiring inside the lamp fixtures, which frequently resulted in breakage of the wire when a maintainer replaced a bulb. The maintainer then had to rewire the fixture.

In the area of command response unit maintenance (Section IV in Table 8), maintainers stated that the basic problem was that it was simply difficult to get to anything inside the unit. Getting to and removing a given component often required removing several other components, thus making maintenance rather time consuming. The comment was also made that the screw heads on the top cover tended to strip, making it difficult to remove and replace the cover.

No problems existed with test procedures (Section V of Table 8). However, the technical manuals were the object of a number of criticisms (Section VI). Several ratings of "Borderline" and "Inadequate" were given to various aspects of them. Individual comments were of the nature of "general inaccuracies throughout" and "not adequately indexed." Additionally, one maintainer complained that the flowcharts in the display control system maintenance manual were not legible.

TABLE 8

MASTER STATION MAINTAINERS HUMAN FACTORS QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; Overall N = 6)

I. TROUBLESHOOTING

Using the scale to the right, indicate with a check mark (✓) the adequacy of the following procedures and BITE tests:						
	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate	Did Not Perform
1. Overall Master Unit troubleshooting procedure.	<u>1</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Display Control System (DCS) Panel Test.	<u>4</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. DCS Off-Line Analog Test.	<u>3</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. DCS Off-Line Digital Test.	<u>2</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. DCS FFK/VFK and Track Ball Test.	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
6. Command Response Unit Test.	<u>1</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>1</u>
7. Troubleshooting with the Portable Test Unit (PTU).	<u>2</u>	<u>3</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>

II. MAJOR EQUIPMENT REMOVAL AND REPLACEMENT

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Remove/replace I/O Terminal AN/UGC-74A(V)3.	<u>3</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
2. Remove/replace Maintenance Panel TS-2940/UYK-7.	<u>2</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
3. Remove/replace Time-of-Arrival Processor AN/UYK-7.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
4. Remove/replace Display Control Processor AN/UYK-20.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
5. Remove/replace Network Control Processor AN/UYK-20.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
6. Remove/replace Cartridge Magnetic Tape Unit AN/USH-26(V).	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>3</u>
7. Remove/replace MU Antenna.	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
8. Remove/replace CPA Radio Filters.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
9. Remove/replace CPA Binding Posts.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
10. Remove/replace cable reels and accessories.	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>
11. Remove/replace cable assemblies.	<u>1</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>2</u>
12. Remove/replace Command Response Unit Pressure Transducer Hose.	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>

III. ELECTRICAL SHELTER SUBSYSTEM MAINTENANCE

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Remove/replace Master Power Circuit Breaker CB1.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
2. Remove/replace Relays K1 and K2.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
3. Remove/replace Relay K3.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
4. Adjust Power Supplies PS1 and PS2.	<u>1</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
5. Remove/replace Power Supplies PS1 and PS2.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
6. Remove/replace Power Control Panel (PCP) Circuit Breakers.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
7. Remove/replace PCP Voltage and Frequency Meter.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
8. Remove/replace PCP Phase Select Switch S1.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
9. Remove/replace PCP Elapsed Hour Meter.	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>4</u>
10. Remove/replace PCP Indicators.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
11. Remove/replace Power Frequency Converter.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
12. Service air conditioner filters	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>2</u>
13. Remove/replace air conditioner filters.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>2</u>	<u>3</u>
14. Remove/replace air conditioner.	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>3</u>	<u>1</u>
15. Remove/replace light fixtures.	<u>1</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>
16. Remove/replace lamps.	<u>1</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>

IV. COMMAND RESPONSE UNIT (CRU) MAINTENANCE.

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
A. CRU time of arrival alignment.	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>5</u>
B. CRU Removal and Replacement.						
1. Remove/replace CRU.	<u>3</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Remove/replace CRU Top Cover.	<u>3</u>	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Remove/replace Pressure Transducer.	<u>1</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Remove/replace power protection circuits A and B.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>4</u>
5. Remove/replace Rubidium Frequency Standard.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>4</u>
6. Remove/replace Memory Buffer A, Unit Memory, Control Buffer A, Line Driver Receiver, and Unit Test Point Circuit Card Assemblies.	<u>3</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Remove/replace Power Amplifier and RF Assembly.	<u>0</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>2</u>	<u>0</u>
8. Remove/replace TSEC/KG-58.	<u>5</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. Remove/replace Fixed Capacitor.	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>4</u>
10. Remove/replace Special Electrical Cable W4.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>5</u>
11. Remove/replace Signal and Message Processor.	<u>0</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>
12. Remove/replace DC Power Converter.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>3</u>

C. CRU Front Panel Component Removal and Replacement.	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Remove/replace Elapsed Time Meter.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
2. Remove/replace LED, DS1, DS2, and DS3.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
3. Remove/replace Power Switch S2 and guard.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
4. Remove/replace Real-Time Clock Switch.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
5. Remove/replace Coaxial Connectors J8 and J9.	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>4</u>
6. Remove/replace CRU Front Panel Handles.	<u>2</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
7. Remove/replace Plate Latch.	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>

V. TEST PROCEDURES.

Using the scale to the right indicate with a check mark (✓) how easy or difficult it is to perform the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Master Unit Prime Power Amperage Test.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
2. Power Frequency Converter Test.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
3. Communications Panel Assembly External Test.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
4. Communications Panel Assembly Internal Test.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>
5. Roadside Light Fixture and Lamp Test.	<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>
6. Curbside Light Fixture and Lamp Test.	<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>
7. CRU Front Panel Power Switch S2 Test.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>
8. CRU Front Panel Real-Time Clock Switch S1 Test.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>

VI. TECHNICAL MANUAL

Using the scale to the right, indicate with a check mark (✓) the adequacy of the PLRS Master Unit Maintenance Manual (DEPTM 11-5825-268-23) in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Completeness.	<u>0</u>	<u>4</u>	<u>2</u>	<u>0</u>	<u>0</u>
2. Accuracy.	<u>0</u>	<u>5</u>	<u>0</u>	<u>1</u>	<u>0</u>
3. Understandability.	<u>0</u>	<u>3</u>	<u>3</u>	<u>0</u>	<u>0</u>
4. Ease of finding necessary information.	<u>0</u>	<u>2</u>	<u>4</u>	<u>0</u>	<u>0</u>
5. Clarity of flowcharts.	<u>0</u>	<u>4</u>	<u>1</u>	<u>1</u>	<u>0</u>
6. Clarity of diagrams.	<u>0</u>	<u>5</u>	<u>1</u>	<u>0</u>	<u>0</u>

VII. REPAIR VAN, TOOLS, AND PARTS.

Using the scale to the right, indicate with a check mark (✓) the adequacy of PLRS in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Type of tools and test equipment issued for maintaining PLRS Master Unit (as specified in Maintenance Manual).	<u>2</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>2</u>
2. Availability of repair and replacement parts (as specified in Maintenance Manual).	<u>0</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>0</u>
3. Storage space for spare parts in repair van.	<u>0</u>	<u>3</u>	<u>1</u>	<u>1</u>	<u>1</u>
4. Storage space for test equipment in repair van.	<u>0</u>	<u>3</u>	<u>0</u>	<u>2</u>	<u>1</u>
5. Work bench space in repair van.	<u>0</u>	<u>2</u>	<u>3</u>	<u>0</u>	<u>1</u>
6. Storage space for COMSEC equipment in repair van.	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>	<u>3</u>
7. Security of storage space for COMSEC equipment in repair van.	<u>0</u>	<u>0</u>	<u>0</u>	<u>3</u>	<u>3</u>
8. Rekey capability for MU and UU.	<u>0</u>	<u>0</u>	<u>2</u>	<u>2</u>	<u>1</u>
9. Illumination in repair van.	<u>2</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>
10. Temperature in repair van.	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>0</u>
11. Ventilation in repair van.	<u>1</u>	<u>4</u>	<u>1</u>	<u>0</u>	<u>0</u>
12. Noise and vibration in repair van.	<u>0</u>	<u>1</u>	<u>3</u>	<u>2</u>	<u>0</u>

VIII. SAFETY

- A. Indicate with a check mark (✓) if any of the hazards listed to the right exist for the following parts of the PLRS Master Unit and repair van:

	Electrical Hazard	Heat Hazard	Structural Hazard (sharp protrusions, edges, loose cables)	Mechanical Hazard (moving parts)	Extreme Brightness	Extreme Loudness
1. Display and Control Station	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Cartridge Magnetic Tape Unit	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Command and Response Unit	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Keyboard/Printer	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. VHF Voice Radio	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Power Control Unit	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. AN/UYK-7 Computer	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. AN/UYK-20 Computers	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. PLRS antenna and mast	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
10. Entrance to/Exit from Master Unit shelter	<u>0</u>	<u>0</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>
11. Other equipment in the Master Unit shelter (specify)	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
12. Portable Test Unit	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
13. Equipment and fixtures in the repair van.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
14. Entrance to/Exit from the repair van.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

The availability of proper tools, test equipment, and repair parts was given inadequate ratings by several maintainers (questions VII - 1, 2, and 8). The major complaints were that a signal message processor was not available during the field test and the maintainers had to use one out of the portable test unit in order to keep the master station maintained; that the maintainers did not have their own KYK-13 for rekeying units; and that a set of Allen wrenches with handles, rather than Allen wrenches with a 90° bend, would make maintaining the equipment much easier.

Some dissatisfaction was also expressed with the lack of space for storing test equipment and manuals in the repair van (questions VII - 3, 4 and 5). Several maintainers stated that racks were needed for securing the test equipment. Also, the screw-on knobs used to secure the cabinet drawers were time consuming to use. A snap-latch type system would be more convenient.

The most inadequate ratings in this section were given to the availability of storage space for COMSEC equipment in the direct support maintenance van (questions VII - 6 and 7). Basically, the problem was that the KG-58 crypto device would not fit into the safe that was installed in the van, which resulted in the necessity of keeping the van itself locked whenever someone was not in it.

Finally, some dissatisfaction was expressed with the amount of noise and vibration which the air conditioners caused inside the van (questions VII - 11 and 12).

In the area of safety (Section VIII of Table 8) several individuals indicated that there was an electrical hazard with the display control station. In the interviews they indicated that they had never been shocked, but that since one is often in an awkward position when repairing the display control station there is the potential for getting shocked. The individual who indicated that there was a heat hazard with the AN/UYK-7 computer said that it became hot and had the potential for overheating, but never was hot enough to burn an individual; the person who indicated a structural hazard with the PLRS antenna stated that there was a danger from falling when one is mounting the antenna; and the individual who indicated a structural hazard with the portable test unit complained that the unit was very heavy and difficult to get up the steps into the master station shelter. The greatest number of safety complaints were concerned with the entrance to the master station. Four of the maintainers complained that when mounting the steps to the master station it was not uncommon to hit one's head on the cable reel that was positioned adjacent to the left side of the door to the shelter. This was a particular problem at night. Positioning the cable reel on the other side of the door would solve this problem.

Master Station Maintainer Training Evaluation Questionnaire

The responses to the Master Station Maintainer Training Evaluation Questionnaire are summarized in Table 9. Perusal of the results indicates that the type and quality of training was generally rated as satisfactory with several individuals frequently indicating that there was not enough training. The comments of these individuals indicated that they generally wanted more hands-on training with the equipment, especially in the area of troubleshooting and fault-finding.

The ratings for the training literature (Section II of Table 9) were "Borderline" for the most part. The complaints, directed at the technical manuals, were the same as those mentioned in the preceding section of this report; namely, the presence of inaccuracies throughout the manuals, and inadequate indexes.

TABLE 9

MASTER STATION MAINTAINER TRAINING EVALUATION QUESTIONNAIRE
Response Summary

(Number of respondents who check each category; Overall N = 6)¹

I. Evaluation of training received in each of the following areas:

A. INTRODUCTION TO PLRS.

1. General Purpose and Use of PLRS

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	5	0	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	5	0	0	0

2. General Familiarization With the Equipment and Safety

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	6	0	0	0

¹Note: Response frequencies in a given row may not sum to 6 because some respondents did not answer all questions in the questionnaire.

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	6	0	0	0

3. System Software, Program Loading, and Function Key Description

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	2	4	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	3	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	3	0	0

4. Display Description

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	6	0	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

5. System Operation

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	2	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	6	0	0	0

B. SYSTEM DISPLAY CONTROL STATION (DCS).

1. Overview of DCS

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	4	0	0	0

2. Component Location Within DCS

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	4	0	0	0

b. The amount of training was

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
0	0	6	0	0

c. The quality of training was

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
2	4	0	0	0

3. Detailed Functional Description of DCS

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
2	2	2	0	0

b. The amount of training was

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
0	0	3	3	0

c. The quality of training was

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
2	2	2	0	0

4. Power Distribution in DCS

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	5	0	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	4	0	0	0

5. I/O Controller and Operator Controls

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	2	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

6. Card, Switch and Track Ball Replacement

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	3	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	2	4	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

7. Processor and Microprogram ROM

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	4	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

c. The quality of training was

0 Very Satisfactory	0 Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

8. Refresh Controller and Memory

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	2	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

9. Description of Line Generator and Deflection Amplifier

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	2	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

10. Description of Symbol Generator and CRT Driver

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

11. Procedures for Digital Fault Isolation

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	4	0	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	4	0	0	0

12. Procedures for DCS Alignment

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	3	1	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	0	1

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	3	1	0	0

C. SPECIAL TEST EQUIPMENT

1. Overview of the Portable Test Unit (PTU)

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	3	0	0	0

2. PTU Operation

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	2	1	0	0

3. Diagnostic Applications of the PTU

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	2	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
3	3	0	0	0

D. COMMAND RESPONSE UNIT (CRU) AND USER UNIT (UU)

1. General Introduction to Command Response Unit and User Unit Configurations.

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	3	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	2	3	0	0

2. CRU/UU Power Amplifier and Basic RF Modules

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	4	1	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	3	1	0	0

3. CRU/UU Basic Processor

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	6	0	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	5	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	5	0	0	0

4. COMSEC Devices

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

b. The amount of training was

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
0	0	3	1	0

c. The quality of training was

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
0	3	1	0	0

5. Frequency Standard and Timing

a. The type of training (Lecture, conference, demonstration, or practical exercise) was

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
0	2	3	1	0

b. The amount of training was

A	B	C	D	E
Way Too Much	Too Much	About Right	Too Little	Way Too Little
0	0	3	3	0

c. The quality of training was

A	B	C	D	E
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Very Unsatisfactory
0	2	2	2	0

6. CRU/Computer Interface

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	3	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	3	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	2	3	0	0

7. Control Panels, Power Supplies and Interconnects

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	6	0	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	6	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	5	0	0	0

E. SYSTEM FAULT RECOGNITION AND TROUBLESHOOTING

1. Overview of Fault Recognition and Troubleshooting

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	3	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	2	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
2	4	0	0	0

2. System On-line Status Monitor Interpretation

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

3. System Diagnostic Program Use

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	2	4	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	2	3	0	0

4. Troubleshooting Problems

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	2	4	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	4	1	0	0

II. The training literature for maintenance training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	1	4	1	0

III. Overall, the amount of maintenance training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	2	0

IV. Overall, the quality of maintenance training on PLRS was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	5	0	1	0

User Unit Maintainer Human Factors Questionnaire

Responses to the User Unit Maintainer Human Factors Questionnaire are summarized in Table 10. It can be seen that no problems were reported in the areas of preventive maintenance, troubleshooting, and equipment removal and replacement. Some dissatisfaction, however, was reported with the technical manual (Section IV in Table 10). In the interviews the user unit maintainers indicated that there was not enough detail in the manual. For example, there were no schematics for showing voltage ratings for the DC power converter, or for showing check points on individual modules. Additionally, there was a lack of information on such items of information as rekeying units and checking the reliability of the portable test unit. The user unit maintainers indicated that they obtained a Hughes portable test unit manual to learn how to accomplish the latter two procedures.

Ratings in the area of repair tools and parts (Section V of Table 10) were generally adequate, but the interviews revealed a number of problems. All three of the user unit maintainers agreed that access to a repair van of some sort was necessary for adequately performing their job. Additionally, they indicated that while they were issued an oscilloscope for maintaining the user units, they did not make use of it because waveform characteristics were not listed in the maintenance manual. The most frequently used pieces of equipment were the multimeter and the portable test unit. Finally one maintainer indicated that a relatively stiff brush should be issued for removing dirt from around the keys of the user readouts.

In the area of safety (Section VI of Table 10), two of the user unit maintainers indicated a heat hazard with the portable test unit. During the interviews, however, the maintainers indicated that the unit itself was sensitive to heat and cold, and did not pose a heat hazard to individuals.

TABLE 10

USER UNIT MAINTAINER HUMAN FACTORS QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; Overall N = 3)

I. PREVENTIVE MAINTENANCE

Using the scale to the right,
indicate with a check mark (✓)
how easy or difficult it is to
perform the following procedures:

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Perform semiannual preventive maintenance checks and services on Basic User Unit.	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>
2. Perform preflight preventive maintenance checks and services on Airborne User Unit.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Clean User Units.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Touchup paint User Units.	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2</u>

II. TROUBLESHOOTING

Using the scale to the right,
indicate with a check mark (✓)
the adequacy of the following
procedures and BITE tests:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate	Did Not Use
1. Manpack Unit troubleshooting procedure.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Surface Vehicle Unit troubleshooting procedure.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Auxiliary Ground Unit troubleshooting procedure.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Airborne Unit troubleshooting procedure.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Built-in Test #1 (started from Basic User Unit Control Panel).	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Built-in Test #2 (started from User Readout or Pilot Control Display Panel).	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Troubleshooting with the Portable Test Unit (PTU).	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

III. EQUIPMENT REMOVAL AND REPLACEMENT

Using the scale to the right, indicate with a check mark (✓) how easy or difficult it is to perform the following procedures:

A. ManPack Unit.

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Remove/replace Readout.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Remove/replace Antenna.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Remove/replace Basic User Unit.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Remove/replace batteries.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Remove/replace sling.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Remove/replace Readout holder.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Remove/replace field pack.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. Remove/replace cargo shelf.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

B. Surface Vehicle Unit.

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Remove/replace Readout.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Remove/replace Basic User Unit.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

C. Airborne Unit.	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Remove/replace Basic User Unit.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Remove/replace Airborne Power Adapter.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Remove/replace Resilient Mount.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Remove/replace Pilot Control Display Panel (PCDP).	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Remove/replace Airborne Antenna Cable.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Remove/replace Bearing Direction Indicator Cable Assembly.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Remove/replace Power Cable Assembly.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. Remove/replace Altimeter Pitot Hose.	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. Remove/replace Signal Cable Assembly.	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
10. Remove/replace Airborne Antenna.	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
11. Remove/replace PCDP On/Off Bearing Knob.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
12. Remove/replace PCDP Brightness Control Knob.	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

IV. TECHNICAL MANUAL

Using the scale to the right, indicate with a check mark (✓) the adequacy of the PLRS Master Unit Maintenance Manual (DEPTM 11-5825-269-20) in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Completeness.	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>
2. Accuracy.	<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Understandability.	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>
4. Ease of finding necessary information.	<u>1</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Clarity of flowcharts.	<u>0</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>
6. Clarity of diagrams.	<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>0</u>

V. REPAIR TOOLS AND PARTS.

Using the scale to the right, indicate with a check mark (✓) the adequacy of PLRS in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Type of tools and test equipment issued for maintaining PLRS User Units (as specified in Maintenance Manual).	<u>2</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. Availability of repair and replacement parts (as specified in Maintenance Manual).	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>

VI. SAFETY.

Indicate with a check mark (✓) if any of the hazards listed to the right exist for the following PLRS equipment:

	Electrical Hazard	Heat Hazard	Structural Hazard (protrusions, sharp edges, loose cables)	Mechanical Hazard (moving parts)	Extreme Brightness	Extreme Loudness
1. Basic User Unit (BUU)	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
2. User Readout (URO)	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
3. Pilot Control Display Panel	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
4. Manpack frame and accessories	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
5. Surface Vehicle Unit mountings for BUU and URO	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
6. Auxiliary Ground Unit mounting for BUU	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
7. Portable Test Unit	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
8. Equipment and fixtures in the repair van	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
9. Entrance to/Exit from repair van	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

User Unit Maintainer Training Evaluation Questionnaire

Responses to the User Unit Maintainer Training Evaluation Questionnaire are shown in Table 11. Generally, the training received satisfactory ratings, although a few "Borderline" ratings occurred in the general areas covering Introduction to PLRS (Section I-A of Table 11) and Command Response Unit and User Unit (Section I-C of Table 11). Individual comments here indicated that more training about how the PLRS, in general, and the user units in particular, operate, was desired.

TABLE 11

USER UNIT MAINTAINER TRAINING EVALUATION QUESTIONNAIRE
Response Summary

(Number of respondents who checked each category; overall N = 4)¹

I. Evaluation of training received in each of the following areas:

A. INTRODUCTION TO PLRS.

1. General Purpose and Use of PLRS

- a. The type of training (lecture, conference, demonstration, or practical exercise) was**

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	3	0	0	0

- b. The amount of training was**

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	1	0

- c. The quality of training was**

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

2. General Familiarization With the Equipment and Safety

- a. The type of training (lecture, conference, demonstration, or practical exercise) was**

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

¹Note: Response frequencies in a given row may not sum to 4 because some respondents did not answer all questions in the questionnaire.

b. The amount of training was

A	B	C	D	
Way Too Much	Too Much	About Right	Too Little	L
0	0	4	0	

c. The quality of training was

A	B	C	D	V
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Unsat
1	3	0	0	

3. System Software, Program Loading, and Function Key Descri

a. The type of training (lecture, conference, demonstrat
practical exercise) was

A	B	C	D	V
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Unsat
0	3	1	0	

b. The amount of training was

A	B	C	D	
Way Too Much	Too Much	About Right	Too Little	L
0	0	3	1	

c. The quality of training was

A	B	C	D	V
Very Satisfactory	Satisfactory	Borderline	Unsatisfactory	Unsat
0	4	0	0	

4. Display Description

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	2	2	0	0

5. System Operation

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	3	0	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

B. SPECIAL TEST EQUIPMENT

1. Overview of the Portable Test Unit (PTU)

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	0	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	0	0	0

2. PTU Operation

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

3. Diagnostic Applications of the PTU

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

C. COMMAND RESPONSE UNIT (CRU) AND USER UNIT (UU)

1. General Introduction to Command Response Unit and User Unit Configurations.

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

- c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

2. CRU/UU Power Amplifier and Basic RF Modules

- a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

- b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

3. CRU/UU Basic Processor

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	2	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

4. COMSEC Devices

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	2	2	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	2	1	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

5. Frequency Standard and Timing

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	3	1	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	2	1	0	0

6. Troubleshooting Problems

a. The type of training (lecture, conference, demonstration, or practical exercise) was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

b. The amount of training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	4	0	0

c. The quality of training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
0	4	0	0	0

II. The training literature for maintenance training was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	2	0	0	0

III. Overall, the amount of maintenance training was

A Way Too Much	B Too Much	C About Right	D Too Little	E Way Too Little
0	0	3	0	0

IV. Overall, the quality of maintenance training on PLRS was

A Very Satisfactory	B Satisfactory	C Borderline	D Unsatisfactory	E Very Unsatisfactory
1	1	1	0	0

SUMMARY AND CONCLUSIONS

Major conclusions which can be derived from the foregoing results are listed in the following sections.

Master Station Operators

The workspace inside the master station has several deficiencies. For example, there is a lack of storage space for combat and wet weather gear. This could be solved by rotating the AN/UYK-7 90° and building a storage cabinet between the AN/UYK-7 and the working shelf. In addition some operators would prefer that the printer and the FM radio be located on the left side of the shelter so that these items would be near the supervisor, who is the individual who primarily uses them.

Additional deficiencies involve the fact that the working area is typically too cool for personal comfort, and the ventilation system is inadequate if several individuals are smoking in the shelter.

Master station operators generally reported no problems in performing the various procedures for operating the system; they did, however, report that the system frequently did not respond to their actions and they would sometimes have to repeat a procedure several times before the system would respond. They also reported that the primary way of detecting that PLRS was being jammed was to notice decreases in the percentage throughput of either the user measurement reports or the RF signals used in time-of-arrival calculations. Both of these pieces of information, however, are noticeable only if one is specifically paying attention to those display functions. Responding to jamming typically involved increasing power and report rates, neither of which was reported as very effective in countering the jamming.

Criticisms of the technical manuals focused on poor organization, not enough information on system alerts, and inaccuracies throughout.

In the area of safety, one individual reported that he received an electrical shock once while mounting the PLRS antenna. Additional complaints were that the steps leading to the shelter were very steep and were slippery when wet. The top of the shelter, which had to be mounted when raising the antenna, also had the problem of being slippery when wet. Finally, the operators complained that the cable reel located just to the left of the door as one entered the master station shelter was poorly located in that one frequently bumped his head against it when mounting the steps to enter the shelter. This was a particular problem at night. The cable reel should be mounted to the right of the door on the outside of the shelter.

Comments about personal discomfort focused on frequently being too cool while in the shelter, and experiencing eyestrain, blurred vision, and muscle strain after sitting at the display control station for

several hours. Operators reported, however, that a short break of 30 minutes would relieve them of these symptoms.

Operating the system while wearing NBC protective masks and gloves presented only minor problems in the areas of mounting the PLRS antenna, connecting cables, and operating the display control station keyboard.

Finally, the master station operators were generally satisfied with the training they received on the system, although they indicated that they would have preferred to have had more hands-on training prior to the field test.

User Unit Operators

Comments by user unit operators indicated several problems with the manpack user units. First, the low battery light, which never seemed to work, should have been located on the user readout so that the operator could see it, rather than on the transceiver which the operator carried on his back. Second, backpacking the manpack unit presented problems in that, besides being somewhat heavy and bulky, the antenna would frequently get hung up in tree branches, or the operator would trip over the cable connecting the user readout to the transceiver. With respect to operating procedures, the operators reported that it was relatively easy to perform the procedures needed to operate the system, but the system frequently responded with "Can't Comply" or "Standby," responses which the operators found to be very exasperating. Additionally, the system would sometimes give a "zone alert" even when an operator knew that he was not in a zone.

Comments about the user readout focused on the fact that it was difficult to read the LED display in the direct sunlight, and that one had to shade it with his hand or body in order to read it in such circumstances. Also, one had to use a flashlight at night to see which keys to press unless one had memorized the key positions. Most operators indicated that they memorized the positions.

In the area of safety, it appears that provisions should be made to secure to the floor the cable which connects the user readout to the transceiver in a surface vehicle. This would prevent entanglement when passengers are getting in and out of the vehicle.

The only problems reported with using the user units while in NBC protective masks and gloves involved trying to press a key on the user readout without pressing several keys at once. This problem was considered minor.

Finally, there was substantial dissatisfaction with the training which user unit operators received. It was generally considered to contain too much technical information and not enough hands-on training. Basically, user unit operators wanted to know what keys to

press to activate useful functions of PLRS, and they did not care to be told about technical aspects of the system, such as time frames and triangulation, which they did not understand anyway.

Unit Leaders

Unit leaders were generally dissatisfied with PLRS. This dissatisfaction focused on the variability in accuracy and timeliness of the position location functions. Most unit leaders felt that when the system was operating correctly, it was an asset to them. But usually the system was not operating correctly and consequently they saw it as more of a hindrance than an asset in conducting tactical operations. This was particularly so with the restricted zone function which frequently gave false zone alerts and consequently tied up the user unit, preventing its use as either a source of position location information or a communications device.

An additional problem concerned using the system as a free text communications device. The problems lay in the fact that messages were frequently received without any indication of who the originator was, and in the fact that it was difficult to know whether another unit had received all or parts of a message that had been sent to it.

Finally, unit leaders voiced the same criticism of the training program as did the user unit operators; namely, that basic hands-on training is needed and not lectures on technical aspects of the system.

Master Unit Maintainers

Master unit maintainer complaints focused on the command response unit and the air conditioning system. The command response unit test and the portable test unit were not highly reliable in diagnosing problems in the command response unit, and once a problem was diagnosed in this unit it was time consuming to repair because of the difficulty in getting to various components within the unit. The air conditioning system was difficult to maintain primarily because of its location at the top front of the master station shelter.

The technical manuals were criticised on the grounds of having general inaccuracies throughout and not being adequately indexed. Equipment deficiencies included lack of a signal message processor, lack of a KYK-13 for rekeying units, and the need for a set of Allen wrenches with handles. In addition, a safe located in the maintenance vehicle and large enough to hold the KG-58 crypto device was needed.

Safety comments focused on the steps and cable reel at the entrance to the master station shelter, as also mentioned by the master station operators.

Finally, training was generally viewed as satisfactory, although more hands-on training with emphasis on troubleshooting and fault finding would have been desirable.

User Unit Maintainers

User unit maintainers voiced few complaints. Those dissatisfactions which they did have concerned not enough detailed information in the technical and maintenance manuals, and the need for access to a maintenance vehicle.